

DESCRIPTION

IAPI6 Rec'd PCT/PTO 07 DEC 2005

# RECORDING APPARATUS OF VIDEO DATA AND AUDIO DATA

5

## TECHNICAL FIELD

The present invention relates to an audio/video synchronization processing apparatus and an audio/video synchronization processing method for synchronizing video data and audio data and an audio/video recording apparatus. In particular, the present invention relates to AV (audio/video) synchronization technology at the time of a pause of the video data and the audio data.

## BACKGROUND ART

For example, in an audio/video synchronization processing apparatus (AV recording apparatus) such as an input device of an MPEG encoder, generally the frame lengths (frame periods) of input signals of the video data and the audio data are different. Further, it is characterized in the point that the audio data and the video data are fetched in periods of frame units. Below, an explanation will be given of the configuration and mode of operation of such a conventional AV recording apparatus.

FIG. 15 is a view of the system configuration of a conventional AV recording apparatus.

This system is configured by a data controller 2a and a system encoder 3a receiving control commands from a host (HOST) 1a.

The data controller 2a receives control commands  
5 from the host 1a at its audio/video controller (AV\_CTRL) 21a and controls an audio controller 22a and a video controller 26a based on time information from a timer (TIMER) 24a.

Note that, hereinafter, the audio/video controller  
10 will be referred to as an "AV controller".

The AV controller 21a issues control commands to the audio controller (A\_CTRL) 22a so as to control the input of the audio data (A\_DATA). The input audio data is stored in an audio data memory (A\_MEM) 23a.

15 Further, the AV controller 21a issues control commands to the video controller (V\_CTRL) 26a so as to control the input of the video data (V\_DATA). The input video data is stored in a video data memory (V\_MEM) 25a.

The data controller 2a provides the audio data  
20 (A\_PTS) and the video data (V\_PTS) given a PTS (presentation time stamp) as time information to the system encoder 3a based on the time information from the timer 24a.

The system encoder 3a is controlled by the control  
25 commands from the host 1a. The audio encoder (A\_ENC) 31a encodes the audio data given the PTS from the data

controller 2a. The video encoder (V\_ENC) 33a encodes the video data given the PTS from the data controller 2a. A multiplexer (MPX) 32a multiplexes the data encoded by the audio encoder 31a and the video means 33a to generate a  
5 bit stream (BSD).

However, in an AV recording apparatus including an MPEG encoder, due to hardware restrictions, the frame periods of the video data and the audio data often cannot be changed. In such cases, if pausing based on the frames  
10 of the video data, when subsequently releasing the pause, there is a problem that the audio data will become offset in synchronization from the video data (AV synchronization offset).

With respect to this problem, unless suitable  
15 processing is performed, the synchronization offset will build up and the viewer will get a strange feeling.

Below, this conventional problem will be specifically explained by using FIG. 16.

FIG. 16 is a diagram showing an example of the AV  
20 synchronization offset when controlling the pause and pause release.

In the conventional AV recording apparatus shown in FIG. 15, the control for fetching the data can only be carried out in frame units. Further, the frame periods of  
25 the video data and the audio data (video\_frame\_time and audio\_frame\_time) cannot be changed even during a pause.

In FIG. 16, when receiving a pause request (indicated as "P" in the figure) from the host 1a, the pause request is reflected in the data controller 2a at the time t161 of a break between frames in the video data  
5 1. The audio data exists in the middle of the frame period at the time t161, and the pause request is reflected in the next audio frame, therefore tp161 is generated as a difference of the video data and the audio data at the time of a pause.

10 During a pause, the frame period of the video data and the frame period of the audio data remain unchanged. The difference tp161 between the video data and the audio data at the time of the pause remains as generated uncorrected.

15 When receiving a pause release request (indicated as "P\_RL" in the figure) from the CPU 1a, the pause release request is reflected in the data controller 2a at the timing of the time t162 of the start of input of the video data n (VDn). Here, at the time of pause release,  
20 when adjusting the timing of the audio data with respect to the video data by considering the difference tp161 between the video data and the audio data at the time of the pause, no AV synchronization offset occurs.

However, since the difference of frame periods of  
25 the video data and the audio data causes generation of the difference tp162 from the time t162 of the pause

release to the time of start of input of the audio input data n (ADn) as the difference between the audio data and the video data at the time of pause release, the result is that an AV synchronization offset tp163 occurs at the  
5 time of pause release from the time t161 and time tp162.

Particularly, when the frame periods of the video data and the audio data cannot be changed, this tp163 may accumulate with each pause request, therefore will sometimes be perceived as strange.

#### 10 DISCLOSURE OF THE INVENTION

An object of the present invention is to provide an AV synchronization processing apparatus and method not causing AV synchronization offset in an AV recording apparatus where the frame lengths of the video data and  
15 the audio data differ and where the frame lengths of the video data and the audio data cannot be changed.

The present invention was made in consideration of this problem. A first aspect provides an audio/video synchronization processing apparatus for synchronizing  
20 video data and audio data having different predetermined frame lengths, comprising:

a timer means;

a storage means for storing a start time of each frame of the video data and audio data, a time of a pause  
25 request; and a time of a pause release request counted by the timer means; and

a controlling means for determining which of the video data and the audio data to delay in frame units after the pause release request or not to delay either based on the start time of each frame of the video data  
5 and audio data, the time of the pause request, and the time of the pause release request.

The controlling means  
calculates an audio delay time constituted by a delay time of the frames of the audio data based on  
10 breaks of frames of the video data at the time of a pause request,

monitors a frame offset time constituted by a difference of the frame start time of the audio data with respect to the video data at each start time of each  
15 frame of the video data after a pause request,

calculates an audio correction time based on the audio delay time and the frame offset time at the time of a pause release request for a pause request, and

determines which of the video data and the audio  
20 data to delay in frame units or not to delay either after a pause release request based on a cumulative audio correction time obtained by cumulatively adding the audio correction time calculated for each pause release request.

According to the first aspect of the present  
25 invention, by acquiring a delay time of the audio data (audio delay time) with respect to the video data at a

point of time when a pause request occurs and constantly monitoring the offset time of frames of the video data and the audio data during a pause after that, no matter when a pause release request occurs, the timing of reproduction of the audio data after the pause release is adjusted so as to suppress the offset of the audio data with respect to the video data to one audio data frame or less, therefore the AV synchronization offset can be greatly suppressed.

10           A second aspect of the present invention provides an audio/video recording apparatus for generating multiplex data including video data and audio data having different predetermined frame lengths, comprising:

          a timer means;

15           a storage means for storing a start time of each frame of the video data and audio data, a time of a pause request; and a time of a pause release request counted by the timer means;

          a synchronization controlling means for  
20           synchronizing the audio data after a pause release request in frame units based on the start time of each frame of the video data and audio data, the time of the pause request, and the time of the pause release request; and

25           a multiplex data generating means for adding time information to the video data and the audio data

synchronized by the synchronization controlling means and generating multiplex data.

According to the second aspect of the present invention, by acquiring a delay time of the audio data  
5 (audio delay time) with respect to the video data at a point of time when a pause request occurs and constantly monitoring the offset time of frames of the video data and the audio data during a pause after that, no matter when a pause release request occurs, the timing of  
10 reproduction of the audio data after the pause release is adjusted so as to suppress the offset of the audio data with respect to the video data to one audio data frame or less, therefore multiplex data having greatly suppressed AV synchronization offset can be generated.

#### 15 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of the system configuration of an AV recording apparatus as an embodiment of the present invention.

FIG. 2 is a flow chart showing processing when an  
20 AV controller 21 receives a START request from a host 1.

FIG. 3 is a timing chart for explaining a video PTS (V\_PTS) and an audio PTS (A\_PTS) generated in response to a start of data input.

FIG. 4 is a flow chart showing processing for  
25 adding a PTS when the data controller 2 provides audio data to the system encoder 3.



FIG. 5 is a flow chart showing processing for adding a PTS when the data controller 2 provides video data to the system encoder 3.

FIG. 6 is a flow chart showing processing performed  
5 by an AV controller 21 based on a pause request from the host 1.

FIG. 7 is a timing chart showing processing with respect to a pause request.

FIG. 8 is a flow chart showing processing after a  
10 pause request processing from the host 1 (processing during pause).

FIG. 9 is a diagram illustrating a method of measurement of a frame offset time (f\_count).

FIG. 10 is a flow chart showing processing  
15 performed in the AV controller 21 when a pause release request is issued from the host 1.

FIG. 11 is a timing chart illustrating a method of calculation of an audio correction time (a\_diff) during measurement of the offset time during a pause.

20 FIG. 12 is a timing chart illustrating a method of calculation of the audio correction time (a\_diff) when not during measurement of the offset time during a pause.

FIG. 13 is a diagram for explaining processing for eliminating AV synchronization offset by processing for  
25 delaying a re-start of input of the video data by 1 frame.

FIG. 14 is a diagram for explaining processing for

eliminating AV synchronization offset by processing for  
delaying a re-start of input of the audio data by 1 frame.

FIG. 15 is a view of the system configuration of a  
conventional AV recording apparatus.

5        FIG. 16 is a timing chart showing pause and pause  
release processing of a conventional AV recording  
apparatus.

#### BEST MODE FOR WORKING THE INVENTION

Below, a preferred embodiment of the present  
10    invention will be explained by referring to the attached  
drawings.

FIG. 1 shows an AV recording apparatus as an  
embodiment of an audio/video synchronization processing  
apparatus according to the present invention. Note that  
15    the AV recording apparatus shown in FIG. 1 has the same  
system configuration as compared with the conventional AV  
recording apparatus shown in FIG. 15, but is  
characterized in the control in the AV controller 21.

Below, successively, processing based on a START  
20    request from a host (HOST) 1, processing in a normal mode,  
processing based on a pause request from the host 1,  
processing during a pause, processing based on a pause  
release request from the host 1, and processing for  
eliminating the AV synchronization offset occurring due  
25    to a pause and pause release request in the AV controller  
(AV\_CTRL) 21 will be explained.

First, the processing performed in the AV controller 21 based on the START request from the host 1 will be explained.

FIG. 2 is a flow chart showing the processing when the AV controller 21 receives a START request from the host 1.

Here, when receiving the START request from the host 1, the AV controller 21 acquires the time information from the timer 24 and stores the same as STC\_offset in a not shown memory. Note that the timer (TIMER) 24 is a timer operating by for example a clock of 90 kHz.

FIG. 2 shows a processing flow of the START request from the host 1 in the data controller 2.

First, when receiving a START request from the host 1, the AV controller 21 waits for a break of the frames of the video data. When detecting a break of the frames of the video data (ST21), it acquires the time information from the timer 24 and holds the time information as STC\_offset (ST22).

Next, it instructs the start of input of the video data to the video controller (V\_CTRL) 26 (ST23) and further instructs the start of input of the audio data to the audio controller (A\_CTRL) 22 (ST24), whereupon the processing in the START request from the CPU 1 ends.

FIG. 3 is a timing chart for explaining the video

PTS (V\_PTS) and the audio PTS (A\_PTS) generated in response to the start of data input.

In FIG. 3, when receiving a START request from the host 1, the AV controller 21 of the data controller 2  
5 starts the input of the video data and the audio data based on the frames of the video. Then, it acquires the time t31 when starting from the timer 24 and holds it as STC\_offset.

Thereafter, at a break of frames of the video data  
10 and the audio data, the AV controller 21 successively acquires the present time from the timer 24, subtracts STC\_offset (t31) at the time of START from this to obtain PTS, and outputs this to the system encoder 3.

For example, in FIG. 3, when detecting a break of  
15 the video data frames, the AV controller 21 acquires the time t32 from the timer 24 and notifies the PTS of the video data together with the video input data to the system encoder 3. When detecting a break of the audio data frames in the same way, it acquires the time t33  
20 from the timer 24 and notifies the PTS of the audio data together with the audio data to the system encoder 3.

Next, the processing in the normal mode after processing the START request from the host 1 will be explained.

25 FIG. 4 is a flow chart showing processing for adding the PTS when the data controller 2 provides the

audio data to the system encoder 3.

When detecting a break of frames of the audio data (ST41), the AV controller 21 acquires the time information from the timer 24 and stores it (ST42). Then, 5 the AV controller 21 generates the audio PTS from the STC\_offset stored at the time of START and the acquired time information (ST43). Finally, the AV controller 21 notifies the information obtained by adding the PTS information to the audio frame data to the audio encoder 10 (A\_ENC) 31 of the system encoder 3 (ST44).

The above processing is carried out in the normal processing mode for each audio input frame.

FIG. 5 is a flow chart showing processing for adding the PTS when the data controller 2 provides the 15 video data to the system encoder 3.

When detecting a break of frames of the video data (ST51), the AV controller 21 acquires the time information from the timer 24 and stores it (ST52). Then, the AV controller 21 generates the video PTS from the 20 STC\_offset stored at the time of START and the acquired time information (ST53). Finally, the AV controller 21 notifies the information obtained by adding the PTS information to the video frame data to the video encoder 33 of the system encoder 3 (ST54).

25 The input of each data is started according to the flow charts shown in FIG. 4 and FIG. 5. The audio data

and video data given PTS and AV synchronized are provided from the data controller 2 to the system encoder 3.

Next, the processing with respect to the pause request from the host 1 will be explained.

5        FIG. 6 is a flow chart showing processing performed by the AV controller 21 based on a pause request from the host 1. Note that when receiving a pause request from the host 1, the time information acquired by the AV controller 21 from the timer 24 is set as  
10    pause\_STC\_offset.

When receiving the pause request from the host 1, the AV controller 21 waits for a break of frames of the video data, while when detecting the break of frames of the video data (ST61), it acquires the pause\_STC\_offset  
15    as the time information from the timer 24 (ST62). Further, the AV controller 21 instructs the stopping of input of the video data to the video controller 26 (ST63) and starts the offset time measurement of the audio data and the video data based on the time information from the  
20    timer 24 (ST64).

Next, the AV controller 21 waits for a break of frames of the audio data. When detecting a break of audio frames (ST65), it ends the offset time measurement of the audio data and the video data based on the time  
25    information from the timer 24 (ST66). Simultaneously, the AV controller 21 stores the offset time of the audio data

and the video data as the audio delay time (a\_delay) (ST67). Further, the AV controller 21 instructs the stopping of input of the audio data (ST68), whereupon the processing in the pause request from the host 1 ends.

5           FIG. 7 is a timing chart showing processing with respect to the pause request shown in FIG. 6.

          In FIG. 7, when receiving a pause request from the host 1, the AV controller 21 suspends the input of the video data based on the frames of video data. The AV  
10       controller 21 stores the time t71 acquired from the timer 24 at this time as pause\_STC\_offset. Then, when next detecting a break of frames of audio data from the time t71 when pausing the video data input, the AV controller 21 acquires time t72 from the timer 24.

15           Further, the AV controller 21 stores the difference between the time t72 and the time t71 as a\_delay and pauses the input of the audio data.

          Next, the processing (processing during pause) after the pause request processing from the host 1 (after  
20       t72 in FIG. 7) will be explained with reference to the flow chart shown in FIG. 8.

          During the pause, as will be explained later, the AV controller 21 measures the frame offset time (f\_count) as the offset time of frames of the audio data and the  
25       video data.

          In FIG. 8, first, it is judged if the operation is

paused at present or not (ST81). If during a pause, a break of the frames of audio data is awaited. When a break of frames of audio data is detected (ST82), the time information is acquired and stored from the timer 24, and the measurement of the frame offset times of the audio data and the video data is started (ST83).

Next, the AV controller 21 waits for a break of the frames of the video data. When detecting a break of the frames of the picture (ST84), it acquires and stores the time information from the timer 24 ends the measurement of the frame offset times of the audio data and the video data (ST85).

Then, the AV controller 21 writes the frame offset time (f\_count) from the time of start of measurement of the offset times of the audio data and the video data in ST83 and the time of ending the measurement of the offset time of the audio data and the video data at ST85 (ST86).

By repeatedly performing the above processing during a pause, the measurement of the frame offset time (f\_count) is continued. The frame offset time (f\_count) is overwritten in the memory in the AV controller 21, therefore indicates the offset time of the latest audio data and video data during the pause. Here, the f\_count is constantly updated because it cannot be predicted when a pause release request will occur, and the system must be ready for the request.



FIG. 9 illustrates a method of measurement of the frame offset time ( $f\_count$ ) explained based on the flow chart of FIG. 8.

When detecting a break of the audio data, the AV  
5 controller 21 acquires the time information  $t91$  from the timer 24 and starts the measurement of the offset time of the audio data and the video data.

Next, when detecting a break of the video data, the AV controller 21 acquires the time information  $t92$  from  
10 the timer 24 and measures the offset time of the audio data and the video data ( $t92 - t91$ ). Here, the measured offset time of the audio data and the video data becomes the frame offset time ( $f\_count$ ).

This control is repeatedly performed based on the  
15 audio data during a pause so the latest frame offset time ( $f\_count$ ) is always stored. In FIG. 9, the latest value of the frame offset time ( $f\_count$ ) is the difference between the time  $t95$  and the time  $t96$  ( $t96 - t95$ ).

Next, the processing for a pause release request  
20 from the host 1 will be explained.

Namely, the method of the AV controller 21  
determining if the re-start of input of the audio data is  
to be delayed or the re-start of input of the video data  
is to be delayed or neither of them is to be delayed and  
25 eliminating the AV synchronization offset based on the time of a pause request and the offset of the audio data

and the video data measured during the pause when a pause release request is issued from the host 1 will be explained.

FIG. 10 is a flow chart showing the processing  
5 performed in the AV controller 21 when a pause release request is issued from the host 1.

Note that a\_diff of the flow chart of FIG. 10 represents the audio correction time constituted by the offset of the audio data and the video data between the  
10 time of a pause and the time of the pause release. Further, total\_audio\_delay in the flow chart of FIG. 10 is the cumulative audio correction time constituted by a variable of cumulative addition of the offset of the audio data with respect to the video data and is  
15 initialized to 0 at the time of system initialization.

Further, as already explained, the frame offset time (f\_count) is updated at the timing of a break of the video data frames. Accordingly, in a time axis, the time from a break of frames of the audio data to a break of  
20 frames of the video data means "during measurement of the offset time of the audio data and video data" in the flow chart of FIG. 10.

For example, the time indicated by the laterally oriented arrows in FIG. 9 means the time during  
25 measurement of the offset time of the audio data and the video data. Times other than this mean times not during

measurement of the offset time of the audio data and the video data.

In FIG. 10, when receiving a pause release request from the host 1, the AV controller 21 waits for a break  
5 of frames of the video data. When detecting a break of frames of the video data (ST101), it updates the STC\_offset (ST102).

Thereafter, the AV controller 21 judges if it is measuring the offset time of the audio data and the video  
10 data or not (ST103). If it is measuring the offset time of the audio data and the video data, the AV controller 21 finds the audio correction time (a\_diff) constituted by the offset time of the audio data and the video data at the time of a pause and the time of a pause release  
15 based on Equation (1) explained later (ST104). If it is not measuring the time, the AV controller 21 finds the audio correction time (a\_diff) based on Equation (2) explained later (ST105).

Details of the audio correction time (a\_diff) will  
20 be explained later, but this represents the offset of the audio data with respect to the video data to be corrected at the time of pause release in pause processing based on the audio delay time a\_delay at the time of a pause and the frame offset time (f\_count). When the audio  
25 correction time (a\_diff) has a positive value, this means that the audio data is delayed with respect to the video

data, while when the audio correction time (a\_diff) has a negative value, this means that the audio data is advanced with respect to the video data.

Next, the audio correction time (a\_diff) found at  
5 step ST104 or step ST105 is added to the cumulative audio correction time total\_audio\_delay (ST106).

Accordingly, the cumulative audio correction time total\_audio\_delay having the initial value 0 at the time of activation of the system is successively cumulatively  
10 added at step ST106 for a plurality of pause processings during the system operation. Contrary to the fact that the audio correction time (a\_diff) is the amount of the offset of the audio data to be corrected at the time of each pause processing, the cumulative audio correction  
15 time total\_audio\_delay becomes the cumulative value obtained by adding the audio correction time (a\_diff) of each time, therefore this becomes the audio data correction value with respect to the video data to be actually corrected.

20 The processing after step ST107 is the processing for determining how the offset of the AV synchronization is controlled, specifically, whether or not the offset of the audio data with respect to the video data is to be corrected, and, in the case where it is to be corrected,  
25 which of the audio data and the video data is to be delayed, based on the value of the cumulative audio

correction time total\_audio\_delay cumulatively added for each pause processing in system operation.

First, at step ST107, when the cumulative audio correction time total\_audio\_delay is negative, that is,  
5 the audio data is advanced, a time having a length of one frame of the video data is added to the cumulative audio correction time total\_audio\_delay (ST108), then processing for actually delaying the re-start of the video data by one frame is performed. The processing for  
10 delaying the re-start of the video data by one frame is realized by waiting for the re-start of input of the video data until a break of frames of the video data is detected (ST109).

When detecting a break of the video frames, the  
15 input of the video data is re-started (ST110).

When the cumulative audio correction time total\_audio\_delay is not negative at step ST107, that is, when the audio data is the same or delayed, the input is re-started as it is without delaying the video data  
20 (ST110), and the routine proceeds to step ST111.

At step ST111, when the positive cumulative audio correction time total\_audio\_delay is 1 audio data frame (audio\_frame\_time) or more, it is necessary to delay the re-start of the audio data, therefore the routine  
25 proceeds to step ST112 on.

When the cumulative audio correction time

total\_audio\_delay is positive, but less than 1 audio data frame, the processing is re-started without delaying the audio data (ST114).

At step ST112, a time of 1 frame length of the  
5 audio data is subtracted from the cumulative audio correction time total\_audio\_delay (ST112), then the processing for actually delaying the re-start of the audio data by 1 frame is carried out. This processing for delaying the re-start of the audio data by 1 frame is  
10 accomplished by delaying the re-start of input of the audio data until a frame break of the audio data is detected (ST113).

When detecting a break of audio frames, the input of the video data is re-started (ST114).

15 Next, a method of calculation of the audio correction time (a\_diff) at steps ST104 and ST105 of FIG. 10 will be explained with reference to FIG. 11 and FIG. 12.

FIG. 11 is a timing chart illustrating the method  
20 of calculation of the audio correction time (a\_diff) during measurement of the offset time during a pause.

The timing chart shown in FIG. 11 shows a case when measuring the f\_count, that is, a case where the audio correction time (a\_diff) is calculated by using the value  
25 of the frame offset time (f\_count) found after the pause release request since the pause release request (P\_RL)

from the host 1 with respect to the AV controller 21 was made during a period from a break of frames of the audio data to a break of frames of the video data.

Below, according to FIG. 11, an explanation will be  
5 given of the routine performed at step ST104 of FIG. 10 in order to calculate the audio correction time (a\_diff).

When receiving a pause release request from the host 1, the AV controller 21 acquires the time t111 from the timer 24 matching with the frame period of the video  
10 and re-sets the STC\_offset based on the pause\_STC\_offset stored at the time of the pause request.

Further, the frame offset time (f\_count) is measured at the timing of the time t111.

Here, a\_delay is the frame offset time of the audio  
15 data and the video data at the time of a pause as already explained and is the data calculated and held at the time of the pause. Further, audio\_frame\_time is the frame period of the audio data.

As apparent from FIG. 11, the audio correction time  
20 (a\_diff) can be found by the following Equation (1):

$$a\_diff = a\_delay + f\_count - audio\_frame\_time$$

... (1)

FIG. 12 is a timing chart illustrating the method of calculation of the audio correction time (a\_diff) not  
25 during measurement of the offset time during a pause.

The flow chart shown in FIG. 12 shows the case

during measurement of the `f_count`, that is, the case where the audio correction time (`a_diff`) is calculated using the frame offset time (`f_count`) found before the pause release request since the pause release request  
5 from the host 1 with respect to the AV controller 21 was made during the period from a break of frames of the video data to a break of frames of the audio data.

Below, according to FIG. 12, an explanation will be given of a routine performed at step ST105 of FIG. 10 in  
10 order to calculate the audio correction time (`a_diff`).

When receiving a pause release request from the host 1, the AV controller 21 acquires the time `t121` from the timer 24 matching with the frame period of the picture and re-sets the `STC_offset` based on the  
15 `pause_STC_offset` stored at the time of the pause request.

Here, `a_delay` is the audio delay time during a pause constituted by the audio data and video data offset time at the time of a pause as already explained and is data calculated and held at the time of a pause.

20 Further, `audio_frame_time` is the frame period of the audio data.

`video_frame_time` is the frame period of the video data. As apparent from FIG. 12, the audio correction time (`a_diff`) can be found by the following Equation (2):

25 
$$a\_diff = a\_delay + f\_count - audio\_frame\_time + video\_frame\_time \dots (2)$$



Next, the processing for eliminating the AV synchronization offset at the time of pause release will be explained in detail using FIG. 13 and FIG. 14.

FIG. 13 is a diagram for explaining the processing  
5 for eliminating the AV synchronization offset by the processing delaying the re-start of input of the video data by 1 frame.

The control for delaying the re-start of input of the video data is realized by correcting the AV  
10 synchronization offset (ST108) and performing processing for delaying the re-start of the video data by 1 frame (ST109) until a break of frames of the video data is found since the cumulative audio correction time `total_audio_delay` is negative (ST107) as already  
15 explained according to the flow chart at the time of a pause release of FIG. 10.

In FIG. 13, when receiving a pause release request from the host 1, the AV controller 21 waits for a break of frames of the video data. When detecting a break of  
20 the frames of the video data (time `t131`), it calculates the cumulative audio correction time `total_audio_delay` based on the processing flow of FIG. 10. This is negative, therefore the input of the video data is re-started after waiting for 1 video frame (time `t132`).

25 FIG. 14 is a diagram for explaining the processing for eliminating the AV synchronization offset by

processing for delaying the re-start of input of the audio data by 1 frame.

The control for delaying the re-start of input of the audio data is realized by processing for correcting  
5 the AV synchronization offset (ST112) when the cumulative audio correction time `total_audio_delay` is 1 audio frame or more as already explained with reference to the flow chart at the time of a pause release of FIG. 10 and delaying the re-start of the audio data by 1 frame  
10 (ST113) until a break of frames of the audio data is found.

In FIG. 14, when receiving a pause release request from the host 1, the AV controller 21 waits for a break of frames of the video data. When detecting a break of  
15 frames of the video data (time `t141`), it waits for 1 audio frame and then re-starts the input of the audio data (time `t142`) since the `total_audio_delay` exceeds 1 audio frame.

As apparent from steps ST107 and ST111 of FIG. 10,  
20 when the `total_audio_delay` is positive and does not exceeds 1 audio frame, neither of the re-starts of input of audio data/video data is delayed. In this case, the offset of the audio data and the video data occurring in the pause processing at this time is cumulatively added  
25 to the `total_audio_delay`.

Of course, even if one of the re-start of input of

the audio data/video data is delayed to eliminate the AV synchronization offset, due to the processing of steps ST108 and ST112 of FIG. 10, the cumulative audio correction time (total\_audio\_delay) does not become 0, therefore the AV synchronization offset is not completely eliminated.

However, according to the AV recording apparatus according to the present invention, during operation of the AV recording apparatus, the cumulative audio correction time (total\_audio\_delay) is always within 1 audio data frame, therefore the difference thereof will not be recognized by the viewer and it becomes possible to sufficiently eliminate the AV synchronization offset.

#### INDUSTRIAL APPLICABILITY

The present invention can be applied to an apparatus for recording or reproducing audio data and video data in synchronization.